THE MODEL ENGINEER

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The MODEL ENGINEER

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12TH MAY 1949 VOL. 100 NO. 2503

SMOKE RINGS

The Irish "Enterprise"

● WE WERE very pleased to welcome, recently, Mr. J. E. Blyth, M.B.E., of Belfast, who is an enthusiastic reader of THE MODEL ENGINEER and a very active member of the Belfast Society of Model Engineers. He brought with him several photographs which we hope will find a place in our pages in due course ; but among them was the one which we have chosen for our cover picture this week.

The train is the Belfast-Dublin flyer which is very aptly named *Enterprise*. It was introduced on August 11th, 1947, and is the first regular non-stop express service between Belfast and Dublin, and vice versa, each week-day. The service that this train provides has proved to be extremely popular, and that is a fitting reward for the enterprise of the owners, the Great Northern Railway (Ireland). The time allowed to cover the 112½-mile distance is 135 minutes, which means an average speed of about 50 m.p.h. ; but speeds of 70-80 m.p.h. have to be attained in places to ensure punctuality. The fine 3-cylinder compound locomotiyes are used for working the service ; the train consists of seven luxurious coaches providing accommodation for 72 first-class and 200 third-class passengers, and weighs 207 tons tare.

Mr. Blyth secured a pretty shot of No. 84, *Falcon*, getting well into her stride with the train, about 25 miles from Belfast.

The Model Railway Exhibition

● THIS FAVOURITE annual event, held, as usual, at Central Hall, Westminster, from the Tuesday until the Saturday of Easter Week, displayed everything that is best in the model railway hobby. Some thousands of individual exhibits served to demonstrate the fact that steady improvement in true-to-scale modelling of locomotives, rolling-stock and all kinds of railway accessories in the smallest scales is being well maintained.

The passenger-carrying track was a constant source of attraction, and the various locomotives working on it seemed to be giving of their best.

The curious sound produced by the exhaust of one of the engines led a wit to ask us if we were enjoying the solo by the flute player!

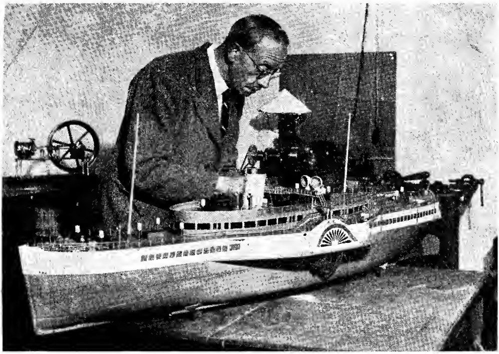
We noted with interest that the engines are now acquiring sight-feed lubricators of the kind so successfully devised by Mr. Fred Cottam ; the device works perfectly and can be adjusted to a nicety, ensuring that valves are adequately lubricated without wastage.

We did not note any newcomers to the stud of locomotives, but apparently there are some being built and they are being awaited with interest ; we understand that one of them is a 5-in. gauge version of the L.M.S. Class 7 0-8-0 engine which should prove to be a massive and powerful addition to the stud. And we heard of a projected 5-in. gauge G.W.R. "Dean" 0-6-0 engine which a young enthusiast has chosen as his first attempt.

Those Southampton Ploughing Engines

● FURTHER TO the "Smoke Ring" published in our March 24th issue, and with particular reference to our enquiry as to whether anybody had managed to take a photograph, a correspondent who signs himself "Civil," seems to be in very close touch with these two engines and has sent us some very interesting particulars, together with a photograph of one of the engines. We print "Civil's" letter elsewhere; but we are particularly gratified to have the photograph.

On thinking over this particular episode, we see that it is another example of the many-sided nature of our readers' interests; seldom do we raise a question which cannot be fully answered by *some* reader. And it has always been so.



Preparing for the Exhibition

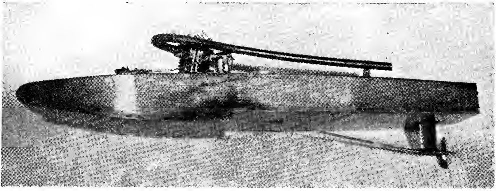
● WE PUBLISH on this page the photograph of a shipmodeller working on his model in its later stages, to remind our readers that at this time of the year those who propose to enter their models in the forthcoming MODEL ENGINEER Exhibition should be very busy adding the finishing touches. Hurried work is never good work, and many a model, which would otherwise have reached the prize-winning level, just missed it because the work had been rushed in its final stages. It seems such a pity, when the design of a model is sound, and good honest work has been put into it in the early stages, that the time element should be overlooked and inferior work allowed to go into it in order that it should be finished in time for an exhibition. We would recommend our readers who are preparing models, to draft out a time schedule timing the dates when certain processes, the painting especially, must be finished to allow a comfortable period to elapse between the completion of the model and its dispatch to the Exhibition. During such a period one can sit back and examine the model from the point of view of the judges, and the many little blemishes that always exist can then be attended to and corrected at leisure. The subject of our illustration is the fine model of the well-known Thames paddle steamer *Royal Eagle* which was highly commended in our 1946 Exhibition. It was built by Mr. Morris Harris, of Cricklewood who is seen in the photograph.

Port Bow

● WE HAVE received a number of letters on the slip in our issue for April 28th when, writing of the photograph of the *Queen Elizabeth* on the front cover, we spoke of what was obviously the port bow of the ship as the starboard. Some of the comments were in rhyme; Mr. G. F. Parker, of Derby, wrote:

Although but a humble landlubber,
With seldom a sight of the sea;
E'en I can reflect on the port side
Termed "starboard" in this week's "M.E."

All were in a pleasant vein and no great harm was done; not even, we hope, to our reputation for accuracy. Oh, well! Even Homer nods sometimes.



In Search of Speed

Further Developments of "Faro"

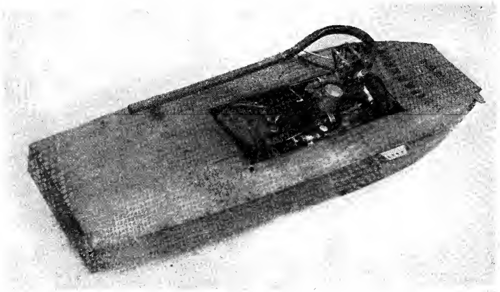
by Kenneth G. Williams

THE high speeds recently achieved by hydroplanes powered by commercially-made engines, both in America and in this country have given rise to the suggestion that the days of home-designed and built racing engines have passed. Let me say at once that I strongly deny any such idea.

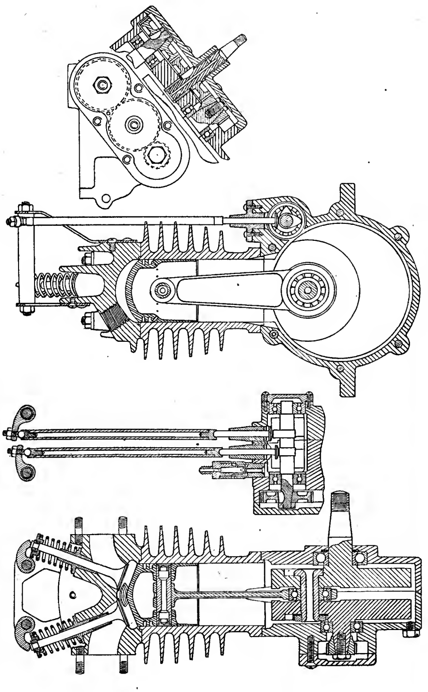
As model engineers, we enjoy the many fields of interest which power boats provide, starting with design and draughtsmanship, the satisfaction of using tools, building and assembling the engine and hull. Next comes the most fascinating part, experimental work in developing engine power output and hull behaviour by observation and deduction from the results obtained.

Finally, there is the competitive element, and the warm social contact with fellow enthusiasts at the pond side, and the associated summer picnic outings to regattas around the country.

No one will deny there is a great thrill of achievement in making fastest time of the day



General view, showing carburettor and fore and aft attachments for "bridle"



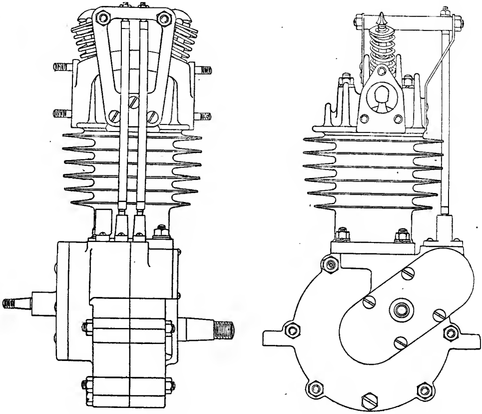
Sectional views of engine, showing details of valve-operating gear

at a regatta or in setting up a new speed record, but this is only a small part of the satisfaction derived from a worth-while hobby founded on the right use of leisure. Our aim should be to develop good craftsmanship and good fellowship, making models and making friends.

I know many readers of THE MODEL ENGINEER share the very great pleasure which I have

Inlet, open 10 deg. before T.D.C., close 45 deg. after B.D.C.; Exhaust, open 55 deg. before B.D.C., close 20 deg. after T.D.C. The ignition firing point was fixed at 40 deg. before T.D.C. The valve ports were $\frac{9}{16}$ in. diameter and the valve-lift was 5/32 in.

The hull is a conventional single-step hydroplane 40 in. long, 12 in. maximum beam, having



Elevations of the 30-c.c. class "A" 4-stroke i.c. engine of the racing hydroplane, "Faro"

experienced in developing home-built engines, and feel they would like further information about *Faro* the 30 c.c. Class "A" racing hydroplane first described in THE MODEL ENGINEER in November, 1938.

When *Faro* was first planned she was intended to have a moderate performance but with a good margin of robustness to allow for subsequent tuning, while at the same time reliability was considered essential. Briefly, the engine is a single-cylinder air-cooled four-stroke $1\frac{5}{16}$ in. bore and stroke, having push-rod operated overhead valves and ball-bearings to the mainshafts, crankpin and camshaft. The general arrangement drawings and the part-sectioned view show the layout.

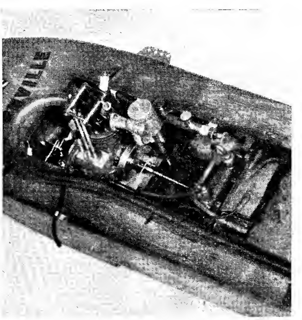
Initially, a compression ratio of 5 to 1 was adopted and the carburettor choke diameter was $\frac{5}{16}$ in. The valve timing chosen was:

the step situated 18 in. from the bows. It is built with plywood planes, sides and deck fastened to a framework of longerons and skeleton formers, and is of stressed skin construction. The fore plane had an inclination of 1 in 33 and the rear plane about the same on the centreline washing out to no lift at the chines. The propeller was about $6\frac{1}{2}$ in. pitch, 3 in. diameter.

The speed first recorded in June, 1936, was 25 m.p.h., and systematic development has more than doubled this figure, compression ratios have progressively increased up to 10 to 1, and as r.p.m. went up, so the carburettor choke has been enlarged proportionately to keep induction air-speed about constant. New camshafts were made, gradually increasing dwell on each valve and giving greater overlap, the present timing being: Inlet, open 30 deg. before T.D.C., close 60 deg. after B.D.C.; Exhaust, open 60

deg. before B.D.C., close 30 deg. after T.D.C. Harmonic-form cams are used.

An automatic ignition advance operated by a spring enclosed in an oil-damped dashpot was added to allow the boat to get away from rest on retarded ignition, and advancing the firing point as she accelerated. This was found necessary because, having very light flywheels, the engine would stall at get-away on the degree of advance necessary for maximum speed. The present firing point is 55 deg. before T.D.C.



The engine of Mr. Williams's "Faro"

A good deal of trouble was met early on in finding small sparking-plugs having sufficient heat resistance, and up to 1939 the Champion range JA 11 to LA 14 provided the solution. These 14-mm. plugs are of the non-detachable type, and were turned down and re-screwcut to 12 mm. × 1.25 mm. pitch, and could just be accommodated in the cylinder-head with the size of valves used. The JA type are ⅜ in. reach, and the LA ½ in. reach.

Lack of suitable valve springs held up development for a time, but a stock motor-cycle clutch spring was found of suitable dimensions having a rate of 11 lb. per ½ in. deflection, which filled the bill nicely.

As might be expected, a large number of mechanical failures have occurred during a hard racing programme. Many were the result of excessive vibration caused by incorrect counter-balancing of the inside flywheels; engine mounting brackets and exhaust pipe attachments were chief offenders, but as balance was improved, these troubles became less frequent.

Capsizes at speed accounted for considerable damage at various times, as water was drawn into the cylinder and brought the engine to a dead stop on the next compression stroke. Many gudgeon-pins were badly bent or joggled in this way, and on one occasion the cylinder barrel itself parted below the top fin, which was bolted to the cylinder-head. Drifting out a bent gudgeon-pin usually strained the piston bosses, which eventually cracked and broke up, necessitating a new piston being made. Every occasion of this sort was generally an opportunity to increase compression ratio a little more.

Gudgeon-pins were originally ¼ in. diameter, but signs of overloading through excessive pressures on such a small bearing area led to an increase to $\frac{5}{16}$ in. diameter, and eventually to ⅜ in. as greater power developed. Pistons originally made of aluminium alloy gave way to magnesium to reduce the weight of reciprocating parts, and a change of material in the connecting-rod from steel to duralumin was made for the same reason, the weight being reduced to one half without sacrificing strength.

At the end of 1939 the speed had been brought up to about 43 m.p.h. and a new magnesium piston, increasing the compression ratio to 10 to 1, resulted in a run at 47½ m.p.h. early in 1940. By this date regattas had been abandoned, and as there seemed little prospect of racing being resumed, *Faro* was run at Bournville Model Yacht Pond to make demonstrations in support of the "Brighter Birmingham Holidays at Home" programme in the war years 1942 to 1944. This hack-work eventually resulted in the crankcase bearer arms fracturing and wear and tear took its inevitable toll in other ways, so she went into honourable retirement on the workshop shelf. During the war the working drawings of the engines were made. They show the state of development at the end of 1939.

The events of 1945 raised hopes of a resumption of racing, so during the following year it was decided to rebuild the engine. Accordingly, the patterns of the crankcase were modified by adding extra stiffening ribs, more metal was added round the camshaft tunnel, which had been rather skimpy, and some new castings in magnesium alloy were obtained. It was decided to increase the diameter of the gudgeon-pin to ⅜ in. and this involved a new connecting-rod and piston which also meant rebalancing, once again, the proportion of reciprocating weight counter-balanced being kept at 55 per cent.

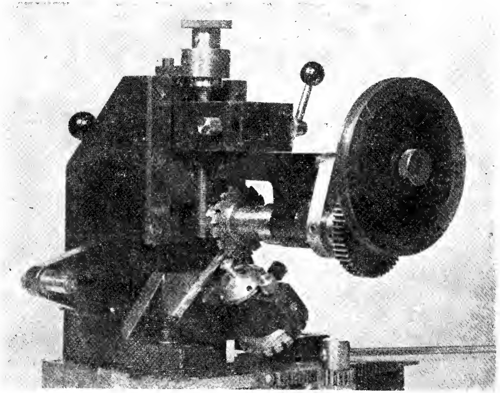
At the same time, the tappet gear was redesigned to provide full width contact between tappet and cam. The centres of the push-rods and tappets did not allow using circular, flat base tappets having a diameter large enough to cover the sweep of the cam tips, so flat-sided tappets bearing against a dividing barrier to prevent rotation were used, and the tappet guide-block was so designed that it may be removed as one unit.

(*To be continued*)

*Constructing a Gear-Cutting Machine

by J. S. Eley

THE feed rack is made from $\frac{3}{8}$-in. square B.D.M.S., and first drill the two $\frac{3}{16}$-in. clear holes. The operation of cutting the teeth presents no difficulty for the milling machine owner, the tooth spacing being obtained by means of the cross-slide index, the tooth pitch in this case being 0.1571 in. Cutting it on a lathe is more tricky but not impossible (what is ?). A suggested method is to run the cutter between centres and clamp the blank parallel to the lathe axis on a vertical slide mounted on the cross-slide. In this set-up the depth of cut is controlled by the cross-slide, the feed by the vertical slide and tooth spacing by the position of the saddle. The latter adjustment is simplified if there is an index on the leadscrew, but failing this an internal micrometer can be used for setting the position of the saddle tooth by tooth, "miking" between the end of the saddle and any suitable projection on the lathe bed. Each end of the rack is finally milled or filed down to form a lug $\frac{3}{16}$ in. thick and the finished part is screwed to the edge of the machine table by two $\frac{3}{16}$-in. Whitworth screws.



Set-up for cutting bevel wheels

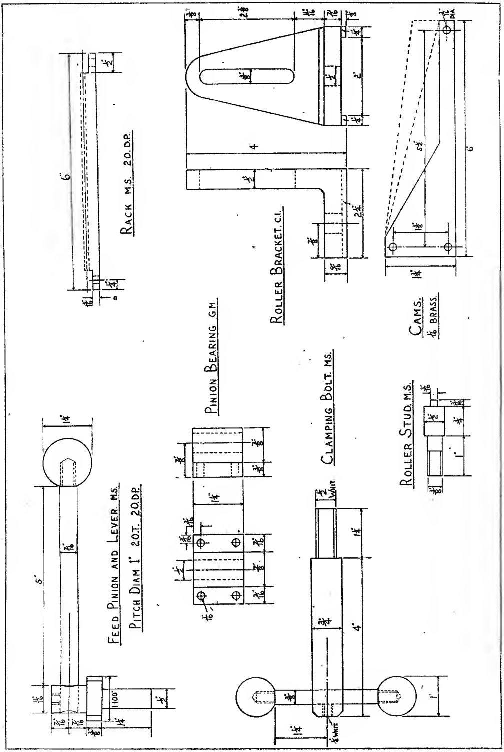
*Continued from page 547, "M.E.," May 5, 1949.

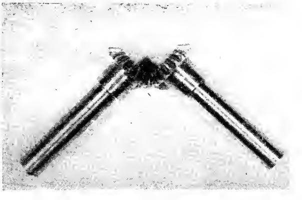
Feed Pinion and Lever. M.S.

If the cutting of all the gears has been left to the last so that they can be cut on the machine itself, this pinion should, of course, be cut first, rigging a temporary feed to the table for the purpose. Once this pinion is cut, a solid feed is available for the cutting of the other gears and indices. The feed lever which can be either $\frac{7}{16}$-in. mild steel or silver steel round bar, fits into a transverse hole drilled through the pinion boss and is held there by $\frac{1}{4}$-in. Whitworth Allen screw. A screwed bakelite knob puts the finishing touch to the other end of the lever.

Pinion Bearing. G.M.

This bearing accommodates the projecting spigot on the underside of the pinion and thus


RACK M.S. 20.D.P.
ROLLER BRACKET. C.I.
PINION BEARING G.M.
CAMS.
1/16 BRASS.
CLAMPING BOLT. M.S.
ROLLER STUD. M.S.
FEED PINION AND LEVER. M.S.
PITCH DIAM 1" 20.T. 20.D.P.



A pair of experimental bevels (50 *D.P.* 20 *teeth*)

allows it to be dropped into mesh with the rack at any point desired. I was lucky in dropping across a suitable gunmetal casting for this part, a large axlebox casting I believe it was, but practically any material will do. It is advisable to drill and bore the ½-in. hole in the lathe as it needs to be reasonably accurate and square to the seating surface. After machining all surfaces except the seating by end-milling, the four $\frac{3}{16}$-in. holes are drilled and tap holes spotted through into the machine base for $\frac{3}{16}$-in. Whitworth screws. The seating surface is now machined or filed down by stages until a good mesh between the pinion and rack is obtained.

Roller Bracket

This can be a casting, a slice off a large piece of angle-iron, or built up from steel plate by brazing, the casting making the most rigid job of course. In any case, a slot will have to be end-milled or drilled and filed to give horizontal adjustment to the roller stud. The base of the bracket is best provided with a small seating pad in each corner as it is bolted to the unmachined side of the main body casting. In positioning the bracket the thing to aim at is to get the point of contact between roller and cam at centre height. This will only be a compromise, however, as varying the angle of cam alters the point of contact so that it is best to provide more than one position. The roller stud is a straightforward piece of work. The portion that passes through the slot in the bracket may be provided with a small peg to prevent the stud turning when being tightened up. The roller itself is a ½-in. × $\frac{3}{16}$-in. × $\frac{3}{16}$-in. bore ball-race of the enclosed type, pressed on. Originally, a roller with a plain bearing was fitted but was found to cause undesirable drag when in contact with the cam. It is surprising how the fitting of the ball-race has improved the sweetness of the action.

Cams

These are cut from 16-gauge sheet brass. If a supply of rectangular pieces 1¾ in. × 6 in. is cut and stored, it is only a few minutes' job to cut a cam of any required angle. After the cam is cut to shape in the flat, it is bent with the fingers round the rotating sleeve to which it is attached by $\frac{3}{16}$-in. Whitworth screws. The cam is kept clear of the surface of the sleeve by small washers $\frac{1}{16}$ in. thick.

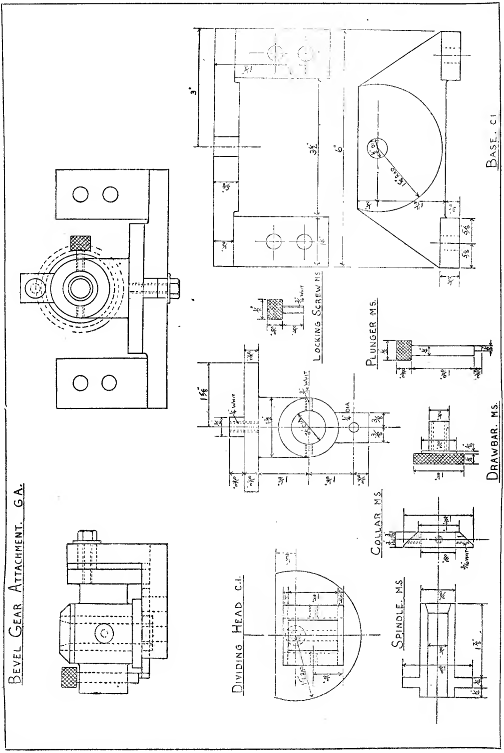
Clamping Bolt. M.S.

Originally the sliding block that carries the swinging arm was locked in position by a ¼-in. Whitworth hexagon headed screw. However, to save fiddling about inside the box casting with a spanner the special clamping bolt shown in the drawing was made up. If a spring washer is used with this, it greatly facilitates the accurate adjustment of the depth of cut.

As the construction of the machine has proceeded, the individual units will have been assembled, no doubt, without any great difficulty. There is only one part of the assembly that is at all tricky and that is the bolting together of the two main parts of the machine—the base and the body. These components must be so aligned, that the dividing-head centre-line and the swinging arm fulcrum are coincident and also that the cutter spindle when locked in the 90-deg. position, is square to the table. If the cutter setting bar has been made up as previously described, this is pushed into the ½-in. bore in the swinging arm spigot, point downwards. The two halves of the machine are clamped lightly together with toolmakers' clamps judging the correct position as near as possible by eye. Using the table feed and the vertical feed, the points of the cutter setting bar and the dividing-head centre are now brought as near together as possible. No doubt there will be some slight discrepancy, and this is corrected by tapping the body casting with a mallet. At the same time the squareness of the body with the table is checked off with a square. When both these adjustments are correct, drill two $\frac{3}{16}$-in. holes through the body base into the machine base and fit locating pegs. The two ½-in. Whitworth clamping screws can now be fitted and the job is complete.

Bevel Gear Attachment

This accessory has been designed with a view to its being used on an ordinary milling machine as well as in conjunction with the machine just described, and so is on the robust side. This arrangement does not admittedly give bevels of true taper-tooth form but in practice, if the tooth face is kept as narrow as possible, the appearance is quite good and they work sweetly enough for most model engineering requirements. Two castings are used, the main one being in the form of an angle bracket. On this is mounted the other casting which forms the body of a simple dividing-head which can be tilted to the angle necessary for the bevel being cut. For this purpose, the machined edge of the semicircular portion of the casting is engraved in degrees. The dividing-head spindle bears on its lower end, a flange to take the division plates already described for use with the machine in its normal capacity, only in this case direct indexing is used. The same collets as

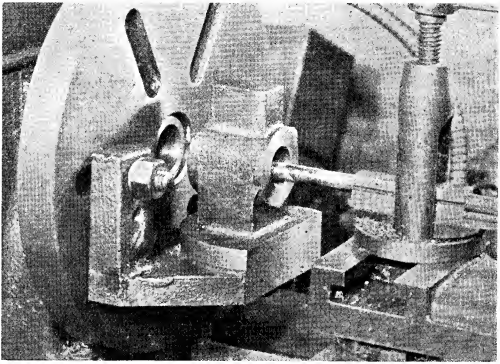


BEVEL GEAR ATTACHMENT. G.A.
DIVIDING HEAD C.I.
SPINDLE. M.S.
COLLAR M.S.
DRAWBAR. M.S.
PLUNGER M.S.
LOCKING SCREW M.S.
BASE. C.I.

used with the main dividing-head are also incorporated, the upper end of the spindle being bored to suit. The gear blanks are either gripped by their bosses or mounted on small pin mandrels held in these collets.

In tackling the main casting the first job is to machine the under surfaces of the two feet. This can be done in the lathe by gripping it crosswise in the four-jaw chuck and taking a cut across (in back gear, of course). This done, the chuck is removed and the casting mounted on a faceplate angle bracket for machining up the back by another surfacing operation. The finishing of this surface is not essential but it looks better and provides a datum surface for subsequent machining. The casting can now either be reversed and bolted flat on to the faceplate or held again in the four-jaw chuck for the facing of the semicircular pad on the inner side, and the boring of the $\frac{1}{2}$-in. hole which locates the dividing-head. This completes the work on this part for the time being.

The dividing-head casting can now be tackled and is held in the four-jaw chuck for turning the $\frac{1}{2}$-in. spigot and for facing and turning the semicircular flange. At the same time the spigot can be drilled and tapped to take the locking screw. Before tapping, however, taper bore the mouth of the hole to 60 deg. inclusive as it will later be necessary to mount the casting between centres for engraving the edge of the semicircular pad in degrees. It is now necessary to mount the casting on the faceplate for boring the spindle housing and the most convenient way of doing this is to mount it on its own angle bracket as illustrated. After clamping the two castings together the bore centre is marked off and also, at the same setting, the position of the two $\frac{3}{8}$-in. locating holes in the bracket feet. These holes receive studs which fit into the $\frac{1}{2}$-in. groove in the machine table thus ensuring that the gear blanks are mounted on the centre-line of the machine. After drilling these holes and the other two which are used for holding down bolts, the whole assembly can be mounted on the faceplate and centred. The spindle housing is now drilled out, bored to size and faced off. While at this setting, a cut is taken across the upper edge of both castings. This will make it a simple matter to realign the two castings in a " zero " position at any time for further operations. The lower end of the housing can now be faced off either by unclamping the dividing-head and swinging through 180 deg. on its bracket or by mounting on a $\frac{7}{8}$-in. mandrel. There are three further holes to drill on the dividing-head ; two $\frac{3}{16}$-in. Whitworth tap holes in the side of the housing for a locking screw and a $\frac{1}{4}$-in. diameter hole vertically through the extended pad to take the locating plunger. This hole should be reamed to size. All three holes are best drilled with the dividing-head mounted on its bracket as it can be swung round and clamped tight in the positions necessary.



Boring the dividing-head casting

(To be continued)

*TWIN SISTERS

by J. I. Austen-Walton

Two 5-in. gauge locomotives, exactly alike externally, but very different internally

I USUALLY make the buffer-stocks from bar, squaring off the backplate afterwards. If you use this method, turn the back flanges to $1\frac{3}{16}$ in. diameter so that, after being squared off, a tiny flat corner is left. It is surprising how this small detail shows up when the job is done, and how much it improves the look of the stock. Mild-steel would be a suitable material, but I don't recommend ordinary brass rod. Some advertiser may be offering castings in gunmetal, and these would be quite satisfactory whatever form the part may take, the outside turning is quite straightforward, and the little collar on the front edge is another point of accuracy and good looks, and should not be left out. The inside is a straight bore right through, and could be finished with a $\frac{3}{16}$-in. reamer if you have one; but it would not be worth while buying one especially for this job. Whether you use bar or castings you will need to drill and insert two little bushes in the position shown. These are simply $\frac{3}{16}$-in. lengths of $\frac{3}{16}$-in diameter rod, drilled and tapped 5 B.A. and silver-soldered into the stocks.

Eight of these are required and care should be taken to see that they are in line both horizontally and across. After silver-soldering, clean out with a file carefully, to remove any projecting surfaces or blobs of silver-solder. The stocks may now be drilled from the pads to which they fit, and marked or numbered to suit. Here again the pads are used as jigs with some arrangement of clamping-bolt passed through the assembly during the drilling operation.

The buffer-heads and stems are a more difficult problem where material is concerned. I feel that stainless material is almost essential for this job, but, as the major diameter is 2 in. and the stem is $\frac{3}{16}$ in. diameter, the use of bar is not only expensive but wasteful. Whether you use mild-steel or stainless steel, the method of making them is the same.

For the stems, take pieces of bar $\frac{3}{8}$ in. diameter and turn down one end to a step as shown. Turn round and face to length, afterwards drilling a $\frac{1}{8}$-in. diameter hole to the depth shown, but don't turn the bar diameter. Take four pieces of $\frac{1}{4}$-in. plate, 2 in. square, or four slices sawn from a 2-in. bar. In either three- or four-jaw chuck, set up carefully to centre. The cavity to correspond with the turned-down spigot on the stem is now made and the rest faced off. The stems can be silver-soldered in, leaving a good fillet of solder round the joint. The $\frac{1}{8}$-in. hole right through the stem is to prevent the stem popping out during the brazing operation as the swelling of the flux is often enough to push out a solid plug. The hole also permits of a central feed for the silver-solder for making certain of a good joint.

When all the brazing is done, each buffer-head is chucked so that the stems run fairly true and the backs of the heads project just $\frac{1}{16}$ in. from the jaws of the chuck. With a small round-nosed tool the stem can be turned down to a sliding fit in the stocks and the backs of the heads may be faced off to leave a thickness of about 7/32 in.

When all the heads and stems are turned to this stage, they may be reversed and held by the stems, using a protective foil wrapped round to prevent jaw marks on the finished surfaces. If you have used square heads cut from plate, the rather bumpy turning down to 2 in. diameter will at least test the quality of the brazing operations. At the same time, the heads of the buffer may be faced back to $\frac{3}{16}$ in. thickness, after which the mushroom radius may be turned. For a guide, mark off and cut out the radius on a piece of metal foil and use this as a check.

Set over the top-slide to 2 deg. and, starting a little way from the centre, draw out a cut to the edge. Then reset the slide to 4 deg. and, starting still further from the centre, make another cut to the outside edge. Follow on with settings of 6 deg., 8 deg., and finally 10 deg., each time starting farther from the centre of the work. The resulting finish will require very little hand-tool or file work to blend out the series of flats so produced, and a session with emery cloth in grades ranging from "garden path" to medium-fine should put the finishing touches to what now appears to be an outsize in buffer-heads.

We need this size of head in order to get out the necessary size oval; but don't attempt to make the ovals yet. Before doing this, set up the heads by the stems, and end-mill a 3/32-in. slot right through the wall of the stems, keeping carefully to the dimensions given for length and position. If your end-mill has seen better days and the resulting slot has rather "woolly" edges, clean out carefully with a very smooth file and finally polish with emery; a key-pin has to slide in the slot and would quickly become worn and sloppy if this were not done.

The key-pins may next be made. Four of these are required with another four dummies to screw into the inside bushes of the stocks. You will notice that the head size—8 B.A. once more—is for general neatness and scale reasons put on this 5-B.A. pin, and the end of the pin has its thread turned down to form the key that runs in the slot in the stem. You can turn these ends to suit the final width of the slot, and that size is not important in itself. The pins, if made in mild-steel could be case-hardened; but in view of the very small amount of wear to which they are subjected, it cannot be regarded

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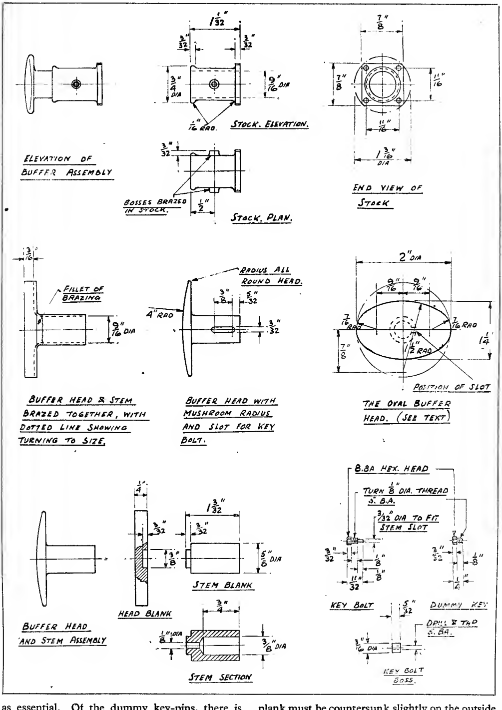
*Continued from page 460, "M.E.," April 14, 1949.



as essential. Of the dummy key-pins, there is nothing to say except that they must not, of course, stick through into the bore of the stock.

The row of rivet holes along the top of each plank must be countersunk slightly on the outside face, and the small brass angles, $\frac{1}{4}$ in. $\times$ $\frac{1}{4}$ in. $\times$ $\frac{1}{16}$ in. should next be riveted on. Try to get the extruded angle-section which is superior

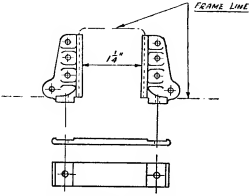
in every way to most folded angle-sections offered for sale. Some of these sections, when bought, are reasonably square in the angle, but the corner radius is usually on the generous side, which means difficulties in getting bolt heads or nuts to sit down comfortably without recourse to spot-facing. You will find at each end of the plank and in the extreme corner where the cut-away runs out to the edge, another hole which should be drilled 6 B.A. clearance. This is quite obviously for the purpose of fixing the running-board's valance-angles to the beams.

The rather long slot for the draw-bar is to allow for the swing of the coupling when working on a tight-radius track. The hook is fixed to a long rod running back to a form of eye which explains away the two mysterious brackets riveted to the No. 2 stretcher. It is not absolutely necessary to make the draw-hooks at this stage. If the little 18-gauge steel gussets have been made, they can now be fitted whilst the beam and stocks are bolted in position. Again I suggest a method as follows :—

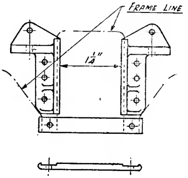
Remove one buffer-stock complete, replacing the holding-bolts through the packing pad, which should be left on the beam. With the pad held in its correct position, put a 2-B.A. bolt through the pad and the beam and lock up. The four normal holding-bolts may now be removed. Assemble and clamp one at a time the two gusset plates behind the beam, making sure that the flanges are arranged as shown on the drawing and seeing that both flanges are in contact with beam and frame side, to say nothing of being square and horizontal both ways.

By the careful arrangement of the clamps on the beam, you can avoid covering the holes for the buffer-stock bolts. Now drill through these holes from the front of the beam, using the fixed packing pad as a jig once more. Mark both drilled gussets, for reference, and then mark and drill each gusset angle making contact with the frame side. Assemble both gussets and buffer-stock with its own four bolts. If necessary, with a light hammer, tap the bolted gusset up or down to make them lie horizontally along the frame face, and drill *in situ*. For future dismantlings it will not be necessary to remove these gussets, and to take down the entire buffer-plank in one complete unit, it will only be necessary to remove the bolts through the frame sides.

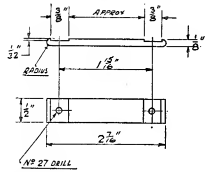
The completion of the ovals of the buffer-heads is the remaining job to be done. Take a small piece of metal shimstock and scribe out carefully the shape of the oval head from the drawing dimensions. Cut out this shape with



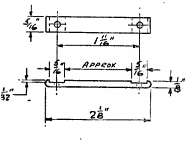
Arrangement of leading and driving horncheeks with keep



Arrangement of trailing horncheeks with keep



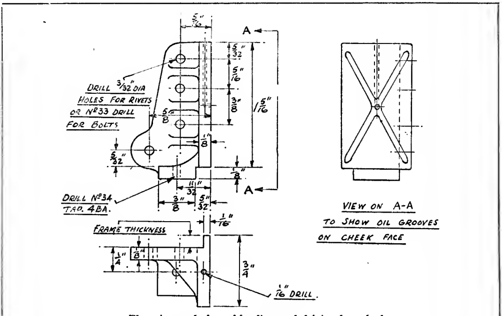
4 off, in steel, for leading and driving cheeks



2 off, in steel, for trailing keeps

workshop scissors, or sharp snips, and smooth up the edge, making any file corrections to the scribed lines. This pattern should have clearly marked horizontal and vertical datum lines running to the edge of the pattern, all part of the marking-out lines, the horizontal line being the one that will be used for location. With marking-out fluid, as described in an earlier issue, cover the four buffer-heads, still in position on the beam, and allow to dry. Mark the exact centre of each head, and, with a steel rule, draw one horizontal line across the faces of both heads. Now place the metal pattern on one of the heads so that its own horizontal datum line coincides with the datum line drawn. A tiny "nick" cut into each end of the metal pattern—cursor marked. Having got the shape correctly filed, follow on with the radius to the edge, filing from both sides to produce a truly rounded edge all the way round. A final bout with various grades of emery cloth should produce a handsome looking head, and well proportioned. By using the method described, it will be seen that the alignment of the heads on the plank is no longer dependent upon truth of the keyway in the stem—the usual stumbling block—as this is done first. The marking of the heads afterwards ensures the ovals being in the correct position.

Some of my readers may, by now, be thinking that I am very unorthodox in the order in which I describe operations. Let me say that although it may appear so in these early descriptions, it



Elevation and plan of leading and driving horncheeks

style—should help you to pick out the line where it emerges from under the pattern.

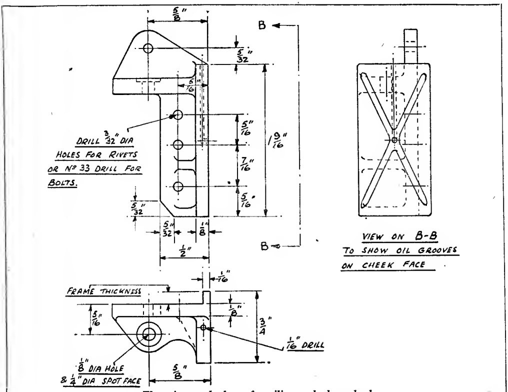
Holding this down firmly with the fingers, draw all round the pattern, and repeat the process for the other three heads. You can now remove the heads, one by one, picking out the scribed line with a small centre-punch all round the outline. This helps you in the sawing and filing operations, for the marking-lacquer is not very durable and quickly comes away from a highly polished steel surface.

I find that the Junior "Eclipse" type of blade will almost go round the entire shape, but the small radius at each end is asking rather too much of the blade, and I leave the corners for finishing with a file. Holding the buffer in the vice between the base of the stem and the domed head enables you to get all round for filing to the finished outline, but be careful to use a brass or soft clamp between the head and the vice jaw, or the polished finish will become dented and will be seen later on that the order I have chosen will eliminate quite a number of unnecessary dismantlings. All the parts so far drawn have got to be made, so why not make and fit them?

With most of the major frame drillings over, the task of making and fitting the horncheeks comes up for consideration. The prototype has separate horncheeks and not the single "horseshoe" variety; the leading and driving axles are on leaf-springs fixed inside the frames and above the axleboxes. The trailing axle also has separate horncheeks, but utilises a system of twin coil springs running up both sides of the axlebox and connected by a short beam under the axle. The horncheeks and springs for our "Major" job will be an almost exact copy of the prototype, but for "Minor" I propose to suggest one or two simplifications that will not spoil the appearance of the locomotive.

To begin with, the castings for both "Major" and "Minor" are the same. The leading and

driving cheeks are alike, and the trailing pair are quite different. Looking at the drawing you will see that the gap between the cheeks will be uniform throughout, and that goes for the plain axleboxes as well as the roller type. The prototype uses bolts with a steeply tapered and slightly domed head for all the horncheek fixings, the domed head going outside the frames. I am using such bolts myself, and all "Major" keeping the size a reasonable one; but on no account allow the "crosses" to break out on any of the surrounding edges. If this is inadvertantly done, fill up the place locally with soft solder, and scrape off the surface of the cheek flat once more. The horncheek ties, or keeps, sit on the small square "tables" left on the undersides of each cheek in the case of the leading and driving axles, and, to be really effective,



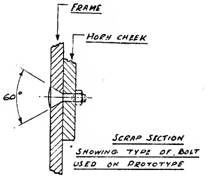
Elevation and plan of trailing axle horncheeks

builders should do likewise if they intend to adhere to strict detail. Good iron rivets, snap-headed on the inside and countersunk on the outside, would admittedly do the job with equal efficiency and I recommend their use for "Minor." You will see also a milled out cross on the sliding faces of all the cheeks, and, on close examination, a tiny hole drilled down from the top face of the cheek and breaking out into another small hole right in the centre of the "cross." The idea is to provide positive lubrication via a flexible pipe to every cheek on the system, thus following full-scale practice. I feel "Major" should have the refinement, and that "Minor" might perhaps run to the "crosses," if only to distribute the oil which may be fed from side passages in the intended plain axleboxes.

A word of warning with regard to these crosses. You may cut these either by hand, by milling or by fly-cutter. In each and every case the actual width of the cut is of little importance other than should be "lodged" as shown on the drawing. File up each "keep," giving it a mark or number denoting its own position, and file away the gaps on the "keep" itself until it will just force on with the fingers. It is then doing a real and useful job of work, and not merely being pinched into contact with the cheek by the somewhat inefficient hold of a single set-screw or bolt. In the case described, the set-screw that you will fit will hold the "keep" in position without its being subjected to strains it is not intended to carry. The "keep" or "ties" for the trailing axle, bolt directly on to the extended horns on the frames, just below the bottom level of the cheeks themselves, and are fixed flat to the frame faces on the inside. Here again, cut out the gaps in the "keeps" so that they lodge and hold the horns together securely, and let the set-screws tapped into the legs of the horn and finished flush outside, do only the job of holding on the "keeps."

On the top wings of the trailing horncheeks

you will notice drilled holes which take the vertical sliding bars of the spring system, and a spot-faced top surface round the hole. This is to provide a shallow well round the rod where it sticks through the cheek, and into this the oil will be fed. The spot-facing, therefore, should be deep enough to hold a number of drops of oil in reservoir style, but don't overdo it and leave the remaining depth of hole too thin ; for this is the only guide there is for the rod, and should this become worn much, the oil would immediately be lost. In the actual fitting of all the cheeks to



the frames, the time-honoured method of the dummy block slipped in between the cheeks during the drilling and riveting operations, has never been bettered. It gives very uniform results, and is simple to put into operation.

As to the actual machining of the cheeks, the men who are fortunate enough to possess shapers, planers or milling-machines will scarcely need advice, but the "lathe only folk" may care to have my opinion. The patterns have been made with the thin fillet edge that goes into the frame thickness, and that in itself is a guide. On both types of cheek, prepare the axlebox sliding face first—either by filing or by fixing it to an angle-plate in the lathe and facing off. This gives the master datum face for the following operations. The plain square ends of the trailing axle set may also be faced in the lathe, on a faceplate, setting the casting on the first face prepared. The little square tables on the other pairs of cheeks can be treated in a similar manner, leaving the edges of the tables for treatment by file only.

The machining of the face carrying the raised fillet could be carried out by end-milling, the casting held in the slide rest and the end-mill running in the chuck. A vertical slide helps in getting the height adjusted quickly, but it is not essential. Once the correct thickness of packing has been found, it will be correct for all the horn-cheeks in the set. The edge of the fillet may be filed back to a guide-plate—any piece of scrap steel the same thickness as the frames and laid on the cheek face abutting the side of the fillet. Once this edge is filed down flat, the corresponding and facing edge on the other side of the cheek should be filed down parallel to the edge of the fillet, and to the dimensions on the drawing. It is not really a precision dimension, as the inside edge is "in the wind," but for the sake of appearances again, try to keep the sizes uniform.

You may now mark out and drill all the holes shown, and spot-face slightly as necessary to give a good head seating for the rivets. If you are using bolts instead of rivets, then the spot-facing should be carried a little deeper, but not much. On the trailing axle pair of cheeks, the drawing shows a developed shape on the top extended platform to the cheek, whereas the casting gives only a straight-sided edge to this part, so as to make the casting "draw" without complications. This again is a point of appearances and, should you decide not to bother with a refined shape, there will be no loss in efficiency and no interference with other working parts. The hole that is drilled through the top platform and carries the spring guide-rod for which the oil-well is recessed, should be equally spaced from the axle-box slide surface in each case ; otherwise you will run into difficulties when matching up the centres of the beams that carry the rods.

By way of a further recapitulation of the frame assembly to date, I feel I can tell builders of "Mincr" that the gussets behind the two buffer-planks may be left out if so desired. The whole frame is so stiff and strong that there is little possibility of trouble occurring. For both "Major" and "Minor," the top row of holes that is drilled along the short raised section of the frames, and which is occupied by the smokebox, may be filled with dummy snap-head rivets, finished flush inside the frames. There is no chance of the "real" type of fixing ever being used, as servicing the locomotive from time to time will call for a quicker method than rivet removal ! Finally, the after diaphragm has a flange butting up to the rear buffer-plank, and two service-bolts should be fitted to the two ends of the flange and drilled through the rear beam.

(To be continued)

Electric Motors for Small Power Tools

In connection with the article by Mr. C. Law, on the construction of tools incorporating *ex*-Government surplus motors, and the subsequent enquiries from readers regarding sources of supplies of these motors, we have received several helpful letters from other readers informing us where suitable motors can be obtained. Apart from advertisers who have already featured them in our displayed or classified advertisement columns, the addresses given include Garland Radio Stores, 4, Deptford Bridge, London, S.E.8, Messrs. J. Deneham, 2, Bury Lodge Road, Stansted, Essex, and Messrs. L. Durrans, 87, Girlington Road, Bradford, Yorks.

Tender for the "Minx"

by "L.B.S.C."

HERE, as promised last week, is the outline drawing of the tender for the "Minx," together with a separate drawing of the frame plates; and I would like to put on record my thanks to Mr. Roy Donaldson, of the Southern Region works at Ashford who kindly got out the dimensions of both "Maid" and "Minx" tenders, from the full-sized articles. This saved my nearly-worn-out noddle a lot of figure-juggling. As will be seen, the tender has a simpler frame and accessories than that for the "Maid," though the dimensions are very similar. The frames are 21 in. overall length, which is the same, and so is the wheelbase of 13 in. equally divided; but the "Minx" tender has ½ in. more overhang at the front end, than at the back. To make the frames, two pieces of 10-gauge blue steel (⅛ in.) 21 in. long and 3¾ in. wide will be required; and there will be no need for me to dilate on how to mark out, drill, and cut to outline, as regular followers of these notes should be quite old hands at the game, long since. Beginners can follow the instructions given for the engine part. The holes for the screws attaching frames to buffer- and drag-beams, are drilled same as on the "Maid" tender; so are the holes for the brake hanger supports, which are $1\frac{7}{16}$ in. from top of frame, $2\frac{5}{16}$ in. behind the centre-line of each axlebox opening, and drilled No. 21. The 8-in. lengths of angle, for attachment of soleplate, are fixed same as the "Maid's," in the middle of the length of the frames.

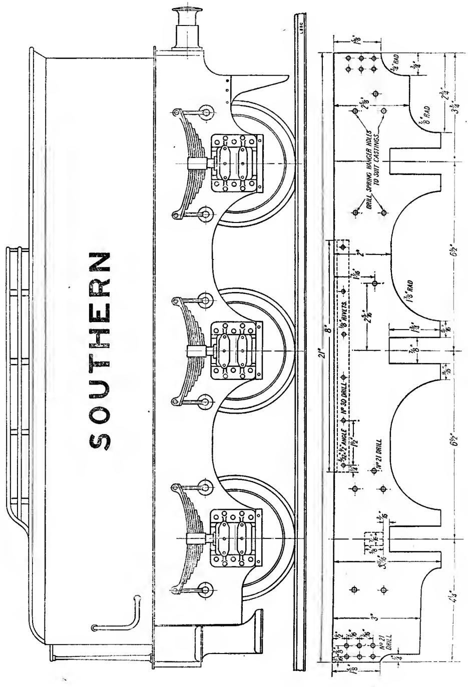
The horncheeks are plain ribbed angles, which our advertisers who specialise in castings for locomotives described in these notes, will be able to supply. They are simpler than the "Maid's," having no lugs at the bottom, and can be machined in the same way, or even carefully filed up on the bolting and sliding faces; but care should be taken to have the two machined faces at exactly right-angles. A try-square will soon indicate if they are correct. They are drilled No. 41, as indicated in the small detail illustration, the rows of holes being 5/32 in. apart, and the holes staggered at 9/32 in. centres. The completed horncheeks are then riveted at each side of the axlebox openings in the frame. Don't forget to put a piece of bar ⅞ in. wide, in each opening, then butt the horncheek close against it, clamp in position with a toolmaker's cramp, remove the bar, drill the holes in the frame through those in the horncheek, and rivet up. The rawest recruit ought to locate the horncheeks correctly by that method. They should be flush with the top of the openings in the frame. Tip for beginners: countersink the holes on the inside of the frame; put your rivets in from the outside, and rest the head of each in a dolly whilst hammering the shank down into the countersink. The dolly is a bit of round or square steel bar about ½ in. diameter, with one end turned slightly taper, the diameter at the end being just a wee bit larger than the rivet head. Make a countersink in the end with a $\frac{3}{16}$-in. drill; put a $\frac{3}{16}$-in. steel cycle ball in the countersink, and give it a few hefty clouts with a hammer, to form a cup. Put this vertically in the bench vice, rest the rivet head in the cup, and you can ferociously assault the stem of the rivet, whilst the head remains undamaged, and retains that pristine beauty of form which delights the heart of Inspector Meticulous.

Axleboxes, Springs and Hornstays

The only difference between the axleboxes on the "Minx's" tender and those on the "Maid's" ditto, is the shape of the ornamental front-plates; so you can go right ahead, and machine and fit your axleboxes to the dimensions given last week. Our advertisers will attend to the matter of the personal appearance of the fronts, if you use castings. If the boxes are machined from bar, the fronts can be made from 16-gauge brass, with the cross straps cut out of the same kind of material, the whole bag of tricks being fixed together by three $\frac{1}{16}$-in. hexagon-headed screws, again to please the worthy old Inspector. It wouldn't be a bad wheeze to solder on the front-plates and the straps as well; for the "rough-housing" a 5-in. gauge goods engine is likely to get on passenger-hauling—especially one with the haulage-capacity of the "Minx" — might result in the loss of such weeny screws. This is where the axleboxes with the ornamental fronts cast integral, score points. The hornstays are merely 2-in. lengths of $\frac{3}{16}$-in. by 3/32-in. steel strip, drilled No. 41 at $\frac{3}{16}$ in. from each end, and attached to the frames, below the axlebox openings, by 3/32-in. or 7-B.A. bolts and nuts. Put the nuts on the outside, and then it doesn't matter if cheesehead screws are used; and put spring washers under the nuts. I've plenty of spring washers on old "Grosvenor"; they came from our Birmingham friend, Mr. A. J. Reeves.

The spring buckles on the "Minx" are slightly smaller than on the "Maid," viz. $\frac{7}{16}$ in. by ⅝ in. instead of ½ in. by ¾ in.; so if cast dummy springs are used instead of working leaf springs, be careful how you drill them to take the same size spring plungers as specified for the "Maid." There isn't much metal to play with, around the hole. The plungers could be made slightly less in outside diameter, say 11/32 in. instead of ⅜ in., and the holes in the springs drilled to suit; but it isn't advisable to have the hole in the plunger less than ¼ in. diameter, as a spiral spring of that size is none too large to carry its share of the weight of the tender when fully loaded.

The cast springs will have the hangers cast integral, the appearance being as shown in the general arrangement drawing. To attach them to the frames, drill a No. 41 hole right through the eye at each end of the spring, then another through



Tender for "Minx," with details of frames

the bottom of each hanger. File off any burrs, and place one spring over the top of the axlebox opening, the bottom of the buckle being $\frac{3}{16}$ in. above the opening, and central with it. Clamp in position with a toolmaker's cramp ; run the drill through the holes in spring eyes and hangers, carrying on right through the frame ; rivet in place with 3/32-in. rivets. If you haven't any long enough, use bits of 3/32-in. wire, iron for preference ; or screws and nuts may be used. Bits of 3/32-in. silver-steel, nutted both ends, would do very well indeed.

If working leaf springs are preferred, they can be made up in the same manner as recommended for the " Maid " ; but the method of attachment is different, if the tender is to be true to life. It would be rather too much of a good thing, to attempt making little leaf springs with forged eyes to the top leaves, so we can effect a compromise. The two upper plates can be made of equal length, and holes punched in them ; I have already explained how to punch spring steel, by aid of a reverse-taper punch and a block of lead. The hangers can be of the bolt type, made from $\frac{1}{8}$-in. round silver-steel screwed at both ends, the upper end being furnished with a circular nut screwed permanently on. The lower end passes through a lug on the tender frame, made and fitted like the hinge lugs on the smokebox door. The whole arrangement is shown in the detail sketch, which explains at a glance, better than any amount of words. Half-round blocks could be used instead of the circular nuts, if desired, to simulate forged eyes.

Erection of Frames

Whilst some folk prefer to erect their frames first, and then adorn the assembly with all the necessary blobs and gadgets, others prefer to fit horncheeks, springs, etc., whilst the frames are separate, and then erect. Please yourselves ! Anyway, the buffer- and drag-beams are the same as on the " Maid's " tender, made from 9-in. lengths of $1\frac{3}{8}$-in. by 1-in. by $\frac{3}{16}$-in. steel angle, which will stand all the " bashing about " that the engine is likely to receive, without turning the proverbial hair. The frames can be attached to the beams either by angles, screws, and rivets, or by brazing or Sifbronzing ; the half-plan of the frame assembly shown in the last instalment, is applicable to both " Maid " and " Minx " tenders.

Cast beams can, of course, be used if desired ; our advertisers supply them. Whilst they are not so resistant to bending as steel beams, they are far stronger than beams made from steel strip ; and more important still, they save a lot of work, as they only need slotting to take the frame plates. It is quite probable that Dick Simmonds will supply complete cast frames as well, as he has already done for several other engines described in these notes, including " Austere Ada," " Iris," " Maisie," and " Hielan' Lassie," the last-mentioned saving all the work entailed in the separate fitting of eight springs and sixteen hornchecks, whilst the personal appearance does not suffer in any way. These cast frames need a wider slot in the beam, than plate frames, and are attached by screws or bolts.

As mentioned last week, the tender wheels and axles for the " Minx " are precisely the same as for the " Maid," so no further drawings are required, and the wheels and axleboxes can be erected in the frames. Anybody who is keeping level with instructions, and needing another job, can cut out and fit the soleplate. This is made from 16-gauge sheet brass or copper, hard-rolled for preference. It is $21\frac{5}{8}$ in. long, and $9\frac{1}{4}$ in. wide ; and is attached to the top of both beams by six $\frac{1}{8}$-in. brass screws and nuts, countersunk at the footplate end, and either those, or ordinary cheesehead or roundhead screws at the back end. Five similar screws are used at each side, to hold down the soleplate to the angles attached to each frame. All the holes are drilled No. 30 ; as with the smaller engines, using nuts underneath, instead of tapping the angles, allows the whole tender body to be completely detached from the chassis, in case any repairs are needed at any time. Next items, tender bodies and fittings.

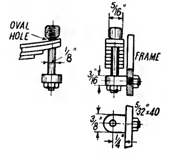
That " Minimum Radius " Curve Again !

Please forgive your humble servant " blowing off," but I do honestly and sincerely wish that good folk who are not only new readers, but newcomers to our craft, would refrain from writing in to me with the eternal " minimum radius " query. Three times in the last two weeks, time of writing, has that confounded question turned up. To quote one example : A reader whose suburban back garden measures 19 ft. across and is 35 ft long, says that as the length is obviously very short for a straight run, he wants to put up a continuous line. He also wants to build " Doris," and what is the minimum radius that " Doris " can be persuaded to go around ? He says he doesn't mind slowing down a little ! I just replied that if he spreads the rails about $\frac{1}{4}$ in. over gauge on his curves, and provides " Doris " with wheels having treads 1 in. wide, makes the bogie wheels small enough to pass right underneath the cylinders, and mounts the bogie in the same way as the bogie of a child's clockwork toy, he can get the engine around all right, at about one mile per hour ! Maybe a few words here, on the subject of engines and curves, may save a lot of disappointment for new readers and beginners, and your humble servant's time.

When it is a case of limited trackage space, and a continuous run is required, the only thing to do, is to select a type of engine that is suited to the road ; and the wider the desired gauge, the smaller the type of engine. Take the case mentioned above. Allowing for, say, 12 in. clearance between the centre of the track and the garden fence—and that would only just allow sufficient room for the legs of a person riding astride on a flat car, to pass between the railway and the fence—we are left with 17 ft. available for the half-circles at the ends of the line ; that is, a curve of 8 ft. 6 in. radius. Now the only type of express passenger engine that would run around that safely, at a speed above a mere crawl, would be a $2\frac{1}{2}$-in. gauge 4-4-0. To get a $2\frac{1}{2}$-in. gauge edition of " Doris " around it, even at very low speed, would mean turning the flanges off the trailing coupled wheels and giving the bogie extra play. But our friend is set on a $3\frac{1}{2}$-in. gauge railway ! Well, he can have it—but the only

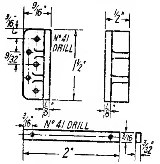
engines that will take him around it, are " Juliet " or " Tich."

My own railway is slightly egg-shaped, due to the shape of the ground on which it is erected. The north curve is 42 ft. across, giving 21 ft. radius, which is slightly irregular at present, owing to the effects of thirteen years of British climate, and several attempts by Jerry to blow it up or set it alight. When that unworthy party couldn't make any impression on the full-sized railway alongside, he adopted the usual method of all bullies, and went for something smaller. Anyhow, that is how it seemed—unless Fatty Hermann was a bit jealous! I might mention that several followers of these notes were in the R.A.F. and they solemnly assured me that Fatty's railway would be " no more " when they found it; and they kept their word. I've often wondered what became of his $3\frac{1}{2}$-in. gauge Borsig Pacific, and the 5-in. gauge " Green Arrow " that he snaffled out of the Maginot Line. One of his 2-in. gauge spirit-fired jobs (not his own make, he had not the skill to build one) is in Canada. He knew all about me, as an American friend who represented a machine-tool firm, met him occasionally and talked about little engines. I guess if Jerry had come out top dog, all my locomotives would have been promptly commandeered by " his greatness."



Hanger for working leaf springs

However, to " return to our muttons," as a famous author said (wonder if he had a presentiment of the 8d. meat ration, and was thinking about the demise of the M.O.F.), the south curve on my road is 35 ft. across, giving a radius of 17 ft. 6 in., slightly irregular, same as the north end. All my $2\frac{1}{2}$-in. gauge Pacifics, including "Tugboat Annie" which has a long wheelbase, also the 2-8-2 " Cock-o'-the-North," will run around these curves at a speed equivalent to 100 m.p.h. or so. The 4-12-2 " Caterpillar," which has no flanges on the two middle pairs of wheels, also has no trouble; whilst the " Mallet," of course, is fully articulated and has only $6\frac{3}{4}$ in. of rigid wheelbase in all her great length. It is when we come to the $3\frac{1}{2}$-in. size that " the shoe pinches." Both " Jeanie Deans " and " Grosvenor " will go around at a scale 80-odd, and keep the road, but they are both small types of six-wheeled engine. " Jeanie's " wheelbase is $13\frac{1}{2}$ in. with $\frac{1}{16}$ in. side-play on the leading axle. " Grosvenor's " is a bare 12 in. without any side-play. On the south curve, the flanges are just tight against the rails, so that an engine with a longer fixed wheelbase would not go around unless the rails were spread, and that would mean that the wheels of an engine with a short wheelbase and treads of normal width, would fall down between the rails. Colonel Simpson's " Claughton," and Mr. John Owen's $3\frac{1}{2}$-in. " King Arthur " will just go around with the bogie wheels scraping the cylinder covers. The late Colonel Dykes's " Royal Scot " won't take the curve at any price, and a $3\frac{1}{2}$-in. gauge Pacific would, of course, be hopeless.



Horncheeks and stay

A $3\frac{1}{2}$-in. gauge 4-6-0 of normal type wants a curve of at least 22 ft. radius, to run anything like freely, whilst a Pacific needs 30 ft. radius, and plenty of side-play on the trailing axle, at that. It is, therefore, obviously useless even to contemplate putting down a $3\frac{1}{2}$-in. gauge continuous line in the average suburban back garden, with the idea of running engines like " Doris " or " Hielan' Lassie " over them. If objections are raised to an engine of 0-4-0 type, such as " Juliet," an 0-6-0 could be used, if the wheelbase is made as short as possible, and the flanges turned off the middle pair of wheels. You can't have it all ways!

For the Bookshelf

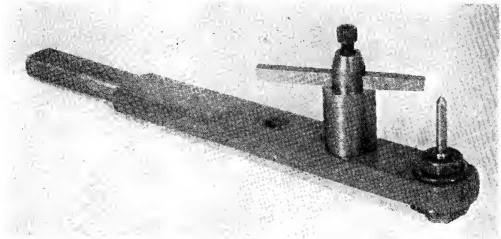
Light and Narrow Gauge Locomotives. By R. W. Kidner. (The Oakwood Press, Tanglewood, South Godstone, Surrey.) 28 pages, size $4\frac{1}{2}$ in. by $7\frac{1}{4}$ **in. Illustrations** on art paper. Price 3s.

This is No. 8 of the Light Railways Handbooks published by the Oakwood Press, and contains some brief historical notes and what appears to be a complete list of light railway locomotives that have worked in Britain since the earliest days. The principal dimensions of each are given, together with makers' names and the dates of construction. The list is arranged in order of wheel arrangements: but we disagree with the comments on what is referred to as " the scale model engine."

* A Universal Swivelling Vice

by "Ned"

IN the construction of the vice actually shown in the photographs, the sequence of machining operations was a little different from that described here, as the roughing out of both the external and internal members was completed before making the tool for generating the spherical curves, and one set-up of the latter thus sufficed for both operations. However, order of procedure is of minor importance so long as the desired results are obtained, and in any case, the tool, when once made, takes very little time to set up for use.



The spherical turning tool, with gauge-pin inserted in pivot bolt

The Spherical Turning Tool

The devices which have been produced for ball turning are legion, and vary from the simple to the highly elaborate, but in all cases the basic principle is the same; they must obviously embody some means of traversing the tool point in a circular arc around a central point which coincides with the spherical axis of the work machined. In the tool to be described, simplicity in design, construction and operation is the most salient feature, and no claims are made for it, except that it will do the job just as effectively and expeditiously as many devices of much more elaborate design. Although made specifically to suit the particular job in hand, it is adaptable to many other operations which involve spherical turning, either external or internal, over a wide range of sizes.

The main body of the appliance consists of a piece of fairly heavy rectangular steel bar, one end of which is turned down to form a hand lever, to facilitate manipulation with reasonable comfort. The actual dimensions of the components are not given on the drawings, as they may have to be varied to suit the lathe used and the available material, but by way of a guide, it may be mentioned that the bar was $1\frac{1}{2}$ in. wide by $\frac{5}{8}$ in. thick, and approximately 12 in. in total length. At the pivot end, a $\frac{3}{4}$-in. hole is drilled and reamed, and the sides lightly spot-faced to produce a true bearing surface. Another hole, $\frac{1}{2}$ in. diameter, is drilled through the bar at a distance of 2 in. from the first; the position of this hole is not at all critical, and for some classes of work it might be desirable to provide two or three holes at different radii for mounting the toolpost in the most convenient position for the particular radius to be machined.

The first hole forms the pivotal centre of the lever, and is fitted with a flanged bush and a washer, adapted to be clamped to the cross-slide of the lathe by the usual tee-bolt, but the latter is in this case drilled and reamed in the centre to take a $\frac{3}{16}$-in. gauge-pin. When the assembly is thus mounted, the bar should be capable of just moving stiffly around the pivot bush; it may be found desirable to make the bush a little on the short side and fit paper or metal shims over it, so that endplay is just eliminated when the washer is clamped down. The toolpost is of the "lantern" type, embodying a central pillar, cross-slotted to take the cutting tool, and an outer spacing-bush, on the edge of which the tool rests. If desired, the bush may be concave-bevelled at the top end, and a crescent packing-piece fitted, to enable the tool point height to

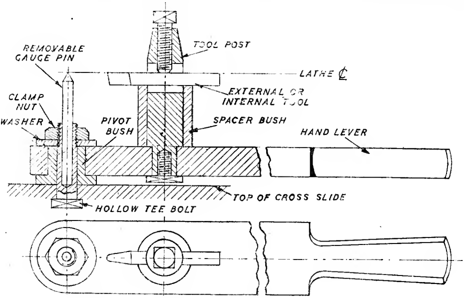
*Continued from page 507, "M.E.," April 28, 1949.

be adjusted, as in the well-known "American type" toolpost; but such elaboration was not considered necessary in an appliance only required for very occasional use. The pillar is shouldered down at the bottom end, and internally tapped for a $\frac{1}{4}$-in. setscrew, which secures it to the bar; it should be capable of rotation in the hole when this screw is fully home, for the purpose of allowing the angular position of the tool to be adjusted when the top screw is slackened.

the lever, than the angular tool position shown in the operational views; and it will also be seen that it was found desirable to use a bent tool in both external and internal operations, for similar reasons.

Setting the Pivot Centre

In setting the appliance to produce a true spherical arc, the gauge-pin is inserted in the tee-bolt and the slide-rest traversed to bring the pin exactly in line with the lathe centre (the chuck is temporarily removed and a point centre inserted in the mandrel socket for this purpose). It is advisable to use a lens to ensure exact coincidence of the centres. The position thus found represents the exact cross location of the pivot *for the finishing cut* on either external or internal arcs. It is quite in order to traverse the cross-slide for bringing the tool into action or taking roughing cuts, but it must return to this location for the final cut. The location must, therefore, be marked by reference to the cross-slide index, or better still, by setting a cross-slide stop, limiting the *inward* travel for external arcs, and the *outward* travel for internal arcs. For setting the longitudinal position of the pivot, measurement may be made from the chuck or faceplate, to ensure that the position of the pivot centre coincides with the required location of the spherical centre of the work.

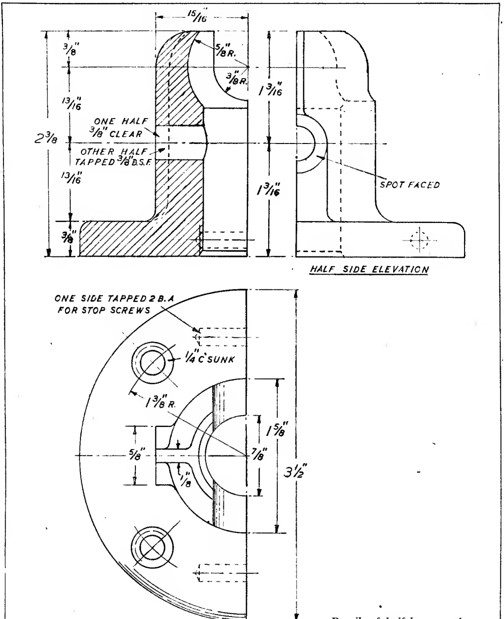


Sectional elevation and plan of spherical turning tool. (Half size)

A gauge-pin is made from $\frac{3}{16}$-in. silver-steel, to fit fairly tightly in the centre hole of the tee-bolt which secures the pivot bush; this should be chucked to run dead truly, and turned down to a 60 deg. point at the top end. The object of this pin is to enable the pivot centre to be located exactly under the lathe centre, and also to gauge the radius at which the tool point is set. It may be mentioned that the complete tool shown in action in the photographs, was made and put into service in about a couple of hours, though it has since been cleaned up a bit, as shown in the photograph subsequently taken, where it is seen dismounted from the lathe cross-slide. It is obviously possible to improve and elaborate the appliance considerably, but whether it is worth while to do so, will largely depend on the amount of work likely to be found for it in individual cases. A simple method of improving the steadiness of operation would be to fit a pad-piece of fairly large area under the bar, outside the radius of the toolpost, to rest on the cross-slide and resist the downward thrust of the cutting tool. The latter is shown in the drawing as set in line with the radial axis of the bar, which is the most efficient on purely mechanical grounds, but it is less convenient for tool setting, and also in respect of operating

Setting the Cutting Radius

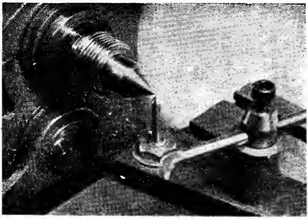
It is now necessary to set the position of the tool point to produce the required radius of arc. First of all, a rough tentative setting should be made, with the object of ensuring that the tool will cover the required angular range without fouling of the tool shank, toolpost, or hand lever,



Details of half base stand

or inconvenient position of the latter. This can be done with the work set up, and the tool set just clear of the surface to be machined. The saddle is then run back clear of the work for exact tool setting, which is done with the aid of the gauge-pin, again inserted in the bolt, but not pushed right home, so that the cylindrical part is level with the tool point—the latter, of course, being set exactly on centre height, which is not only correct in general practice, but even more important in spherical turning.

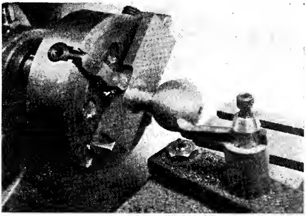
The tool point radius may now be set by means of calipers or other accurate measuring instruments, gauging internally between the tool point and the pin for external machining, and externally over the tool point and the pin for internal machining, with allowance for the radius of the pin in each case. Thus, in the case of the work



Setting the zero position of the pivot, with the aid of the gauge-pin

under discussion, where the diameter of the ball and its seating is $1\frac{1}{4}$ in., the internal calipers are set at $\frac{5}{8}$ in. — 3/32 in. = 17/32 in. for the external tool, the external calipers are set at $\frac{5}{8}$ in. + 3/32 in. = 23/32 in. for the internal tool.

Any error should be in the direction of "tightness," i.e., making the ball slightly larger than its seating, as this gives some latitude for subsequent correction, if it should be found necessary.



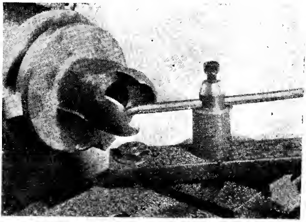
Turning the ball on soleplate, with external cutting tool

In the turning of the ball on the vice soleplate, it will generally be found desirable to dispense with the use of the back centre to support the work, as this will cramp the range of lever movement, but as only light cuts have to be taken, the need for such support is not very pronounced. The cross-slide is run back from the work, the pivot being set longitudinally to coincide with the position of the ball centre, and the cross-slide then fed in until the tool begins to cut ; in the initial stages, the work will not be spherical, but oblate, approaching closer to a true sphere as the pivot centre gets closer to its final position. The hand lever should be fed as steady as possible while traversing the tool in an arc, and on the final cut, several sweeps should be made in order to eliminate spring and obtain as high a finish as possible. When tested with a micrometer or calipers over the diameter at various angles, the work will be found constant in size within about 0.001 in. if correct procedure has been followed, and of sufficiently high finish to require only polishing with emery cloth.

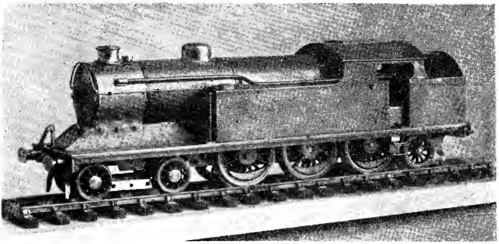
Base Stand

This is made in the form of a single casting, which requires to be split after machining, but this is considered simpler than the use of two castings, which would have to be firmly clamped together during the essential operations ; constructors may, however, please themselves in details of procedure. Although cast-iron is specified and strongly recommended for the other castings of the vice, it is optional in the case of this casting, which entails the heaviest machining operations ; the use of aluminium alloy for this part would be quite satisfactory. It will be noted that in the detail drawings, a stiffening rib is shown extending from the top of the clamp-screw bosses to the top of the cast-

(*Continued on page* 587)



Machining the seating in base stand, with internal cutting tool



Gauge "1" and Why

by K. E. Trask, A.M.I.C.E., A.M.I.Mun.E.

"WHY did you choose that gauge?" is a question which will usually provoke a very interesting discussion among model locomotive engineers. It is also a most important topic for beginners in the hobby, and as a "near beginner" myself, I venture to give my own views. In doing so I do not wish to start a modern "Battle of the Gauges," but hope that the "Big Noises" on this subject may come forward with their views and experiences for the benefit of us all.

One of my regrets is that I did not become aware of THE MODEL ENGINEER and all it means to modellers until 1944, when I was 34; so, in addition to all those "lost years," I may have missed many an article on this subject. Since I have been reading THE MODEL ENGINEER the question of gauges has, of course, cropped up, but, except for the views expressed by "L.B.S.C." I cannot remember any article devoted entirely to it.

Probably, a modeller's choice of gauge has not resulted from deliberate thought on the subject, but because of some chance happening, or admiration of another's work in the same scale. Comments on this aspect, too, would be very interesting. What made Mr. V. B. Harrison, for instance, go in for gauge "1"? Why do some people build 3½-in. gauge locomotives with no chance of laying down tracks large enough to run them?

I know why *I* chose gauge "1." The main reason was that, by profession, I am a civil engineer, and although I have never realised my youthful ambition to go to Africa and throw railway bridges over every chasm I came to, I still hanker after building a line, if only in miniature. *That* would be my *real* interest. I would survey the line, work out its route and features, design its cuttings and embankments, bridges, viaducts, gradients, curves, etc. The great problem of the most suitable form of track, how to get a "low maintenance" permanent-way capable of standing climatic changes, but always giving "jolt-proof" running, would be (and I hope *will* be) of absorbing interest.

In order to build such a line of reasonable scale length, one must, unless one is fortunate enough to be another "Bro. Wholesale," choose one of the smaller gauges. Now, had I been a modeller in my youth I would very probably have chosen gauge "O," and have purchased most of the rolling-stock; but, being well into the thirties, I felt I should make everything myself. That has become one of my "creeds"—and I believe it to be a good one. So many so-called "model engineers" limit their activities to putting together ready-made kits. Perhaps it doesn't matter, as long as they get fun and recreation from it!

As I had the urge to make it all by my own efforts, I had some little fear that gauge "O" would be too much of a "watchmaking" job for a beginner. Gauge "1" attracted me and seemed to have points in its favour. I decided to make a locomotive to a scale of ⅜ in. to 1 ft. and at that scale the gauge of 1¾ in. is almost "dead on" the 4 ft. 8½ in. full size. That seemed sense. Also, at ⅜ in. to the foot, a mile of real track would be represented by a miniature track of 165 ft. The possession of such a track, I hoped, would be possible one day. Then again, if I became proficient in the work I felt perhaps I might try a ½-in. scale coal-fired model, and if I did, by choosing a New Zealand or South African type, I could run it on gauge "1" track. At that scale, 1¾ in. represents the 3 ft. 6 in. gauge of those countries.

Having decided on gauge, I wanted to start building a locomotive. " L.B.S.C.'s " " Chingford Express " had just appeared ; but as I was " innocent," if not " young," I felt I could improve on that ! ! I wanted plenty of wheels, so I looked through " British Locomotive Types " and found that the L.N.E.R. Class " A5 " had the following advantages from my viewpoint : (*a*) Lots of wheels ; (*b*) a " straight-through " footplate ; (*c*) coupled wheels close together (to help on curves) ; and (*d*) inside cylinders (so that it could be made like " Chingford Express ").

I drew out my own design, including sprung driving axles and a " patent " boiler arrangement, but have often wished since that I had known of " L.B.S.C." long enough to have had more respect then for his knowledge and experience. It's nice to make up one's own designs, but it's undoubtedly safer to learn from one's elders ! !

However, that engine was started on Christmas Day, 1944, and one day it will, I hope, be in steam—but now as an L.N.E.R. Class " A8 " with outside cylinders ! Having no lathe and no machine tools whatever, I have been forced to build it " cart before the horsepower." At a quick glance, the locomotive looks almost complete, but has no cylinders, motion, etc. I have now turned the wheels on a friend's lathe and hope to tackle the cylinders soon ; but all my previous turning was done with a file in one hand and the work turning in a handbrace held in the vice. To me, too, it is great fun to make an item out of something completely different. The steam dome is the tail-end of a cannon-shell case turned up as described. The smokebox door is made from a brass sink waste-plug. The buffers are made from electric lamp socket plungers. One grows to see possibilities in almost everything.

My " daydream " is to build this scenic line and to have speed control by one or other of the possible methods. I am fortunate in having as a garden a disused gravel-pit, complete with all such features as hills, valleys, gorges, etc., and ample room for *miles* of $\frac{3}{8}$-in. scale track. It will mean a tremendous amount of work to realise this " daydream "—but who would be without an aim in life !

I fear that this is a very personal article, but I would be well rewarded if " L.B.S.C.," V.B.H., J.N.M., etc., took up the strain—and I also hope that by setting down my thoughts I may start even *one* other person on the pursuit of a hobby which I feel sure will bring happiness and recreation—things so much needed in these days.

A Universal Swivelling Vice

(*Continued from page* 585)

ing. This rib is not provided on the vice shown in the photographs, and is not really necessary in the case of an iron base.

Some constructors may prefer to machine the base all over externally, and to spot face the bearing for the shoulder of the clamp-screw or fit a saddle pad. It may in such cases be possible to use existing material in either cast-iron or steel, such as a coupling or the flange end of a motor-car crankshaft.

It is recommended that the base of the casting should be faced, and a parallel cut taken through the bore before setting-up for machining the top end. For this purpose, the casting should be held in the four-jaw chuck, with the flange outwards, the top part being set to run as truly as possible, and the flange set true on the face with a mallet before fully tightening the jaws. Bore out the centre to $\frac{7}{8}$ in. dia.—the main object of this is to reduce the work to be done at the top end of the bore—and chamfer the mouth of the hole, so as to enable a pipe centre to be used for supporting the work while facing the flange and skimming its outer edge. If no pipe centre is available, turn a short spigot to fit tightly in the hole, and centre-drill it at the outer end.

The casting is now reversed and held either in the reversed chuck jaws or on the faceplate, with the machined bore running truly, for roughing out the spherical clamp seating, and final generating of the arc with the special tool, using the methods already described. Before removing the work from the lathe, it is as well to mark out the centre-line for splitting the casting, and another at right-angles to it, to locate the centres of the clearing and tapping holes for the clamp-screw in the respective halves. It may be noted that the vertical location of these holes is arranged to bring the screw as close as possible to the centre of the seating, but if placed any closer the screw will foul the ball, so this should be carefully watched.

To split the casting, a hacksaw may be used, but a circular saw in the lathe will produce a cleaner result, if it is available. In either case, some cleaning up of the surfaces may be found desirable on the grounds of neatness ; the width of the gap is of little importance, so long as it is parallel. The position of the stop-screws in one side of the base is not important, but fairly wide spacing is desirable, and they are $2\frac{1}{2}$ in. apart in the example illustrated. After drilling and tapping the holes for the clamp-screw, the boss surface should be faced square with the hole, to provide a true bearing for the shoulder of the screw.

(*To be continued*)

A Portable Self - Contained Workshop

by Dr. R. Stewart Kennedy

The workshop, with all tools packed away

THIS portable workshop has given so much satisfaction that it was felt a description of it, illustrated by photographs, might be helpful to other model engineers.

Briefly, I had to give up my workshop, temporarily, had six months' notice of this; and the time was occupied in making a workshop which would be entirely portable, self-contained, and capable of being used in any corner of any room where there was an electrical outlet plug.

It was realised that such work as could be done would be small, but in over a year's use it is surprising what has been made with its aid—petrol lighters, an oscillating steam engine, and numerous clock repairs.

After much scheming and planning, a mahogany box 18 in. × 14 in. × $5\frac{1}{2}$ in. with divisions was made. It is strong and rigid, and has a leather carrying strap. The top forms the bench, and on it may be mounted the lathe, grinder, vice, and driving motor.

1-in. brass discs, $\frac{1}{8}$ in. thick, were let into the bench top to provide mountings for the "machine tools," and angle brass with nuts silver-soldered on the inside forms the vice mounting. Inside the box when all is packed away, the lathe and motor are held to the bottom by screws to prevent damage.

The lathe has a centre height of $\frac{3}{4}$ in. ($1\frac{1}{4}$ in. in the gap) and takes 3 in. between the centres. This sounds almost ridiculous, but it is really perfectly practical.

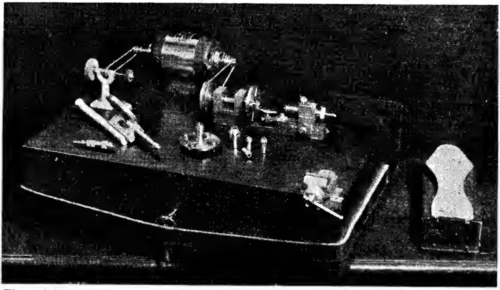
Its accuracy is within 0.002 in. on a dial indicator test of a rod held in any of the collets. The bed of the lathe was one of a pair of engineer's parallels (not hardened) $6\frac{1}{2}$ in. × $\frac{5}{8}$ in. × $\frac{3}{4}$ in. The gap was cut on an "Adept" shaper, as was the headstock from a $2\frac{3}{4}$ in. length of 1-in. × $1\frac{1}{2}$-in. mild-steel bar. This was carefully mounted on the boring table of my Myford lathe, and with a boring-bar between centres after drilling, carefully bored right through to take standard $\frac{1}{2}$-in. ball journal bearings. Steel plugs drilled to clear the mandrel were pressed into the headstock bore from each end, then the ball-races; giving the greatest possible width between the bearings. The mandrel was turned up from mild-steel and is $\frac{1}{4}$ in. diameter threaded $\frac{1}{4}$ in. B.S.F. at the nose; and with a register for the faceplate and a collar wide enough to cover the front bearing. The mandrel was drilled $\frac{1}{8}$ in. and reamed with a 2/0 standard taper pin reamer to take a taper pin on which the centre was turned *in situ*, a hollow centre being made also, after a 2-in. diameter steel pulley had been mounted on the tail of the mandrel.

The faceplate is as large as possible—$2\frac{1}{4}$ in. diameter × $\frac{1}{8}$ in. thick, and with four slots, each $\frac{3}{16}$ in. wide.

The collets, although unorthodox, are very successful. The collet housing is bolted to the faceplate when required, being located by two pegs in reamed holes. No doubt it would have been better to recess the housing disc to spigot, as it were, on the faceplate, but this would have meant a smaller faceplate. The collets were drilled and reamed actually in the housing which was made in a jig turned up to take it, in a disc of steel held in the four-jaw chuck of the Myford —every possible precaution being taken to ensure accuracy.

It will be noticed that the collets close on to the job they are holding by external pressure from a screwed sleeve—the inside taper of which was cut, of course, at the same setting of the top slide (30 deg.) as the taper on the collets.

The tailstock is also a bit of the fellow "engineer's parallel" to that used for the lathe bed. The clamping to the bed is by means of "dimples" drilled in the sides, and is quite rigid in use. This can be seen in the photograph. The tailstock spindle is hollow and screwed internally $\frac{1}{4}$ in. B.S.F. to take two sizes of drill chuck, as well as the pointed and hollow centres. The chucks are "Eclipse" pin vices with the tubular "handles" replaced by screwed plugs drilled hollow. They also fit the miniature hand-drill seen in the photograph. The hand-turning rest is hardened, and turning is done with tools



The workshop ready for work. The hand-drill with one chuck screwed in, and the other larger one lying beside it, can be seen in front of the grinder. The collet chuck housing, " draw in " nut, and three of the collets, are in the foreground. The drill chucks fit the lathe tailstock

filed up to shape from 1/8-in. silver-steel, hardened and tempered.

The hand-drill was quite simply made, the body being an old V-block shaped out and drilled, and bushed with bronze for the spindle. The gears are a pair of Bond's 4-1 steel bevel gears, and the mounting of the large one was rather difficult, but was finally done by turning and shaping a fitting which could be bolted to the end of the body, leaving the turned part projecting to form the spindle for the gear wheel. The drill takes the lathe tailstock chucks as well as a plain chuck for a set of clock drills up to 1/8 in., all having the same diameter shanks.

All the usual hand tools are carried in the box, including screwing tackle—4, 8, and 10 B.A. and 3/32 in. and 1/8 in. Whit. Soldering (hard and soft) can be done, the blowlamp being the German spirit variety with a detachable flame tube, called the " Piccoloachat."

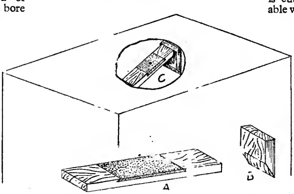
The vice is a Swiss watchmaker's—" The Favourite," and the grinder, while really a toy, can be driven at such high revs. that it deals with turning tools and drills with its two 3/4-in. × 1/4-in. wheels quite adequately.

The motor is 1/10 h.p. and has a foot control which is well worth while, even if it does take up a lot of room in the box.

My home workshop, with THE MODEL ENGINEER, has kept me from feeling out of touch with the only really satisfying spare time occupation—model engineering.

Lining off a Bore

THE model maker in particular will find the following method of lining off a rough bore in a casting most useful. In the workshop, the marker-off uses lengths of lead which he knocks into the bore, and then scribes his diameter by pressing the point of the dividers into the lead for a centre. The following idea is similar, only the item is so made that the model maker can include it in his tool kit. A dovetail recess is cut in a piece of suitable wood and a lead strip shaped and driven in as indicated at *A* in the sketch. A wooden wedge is made as indicated at *B*, and the strip is held in position in the bore as indicated at *C*. A number of these strips can be made in different lengths to cope with varying size bores, if the demand arises.—W. J. SAUNDERS.



PRACTICAL LETTERS

Compression Pipe Joints

DEAR SIR,—*Re* reply to my previous letter by Mr. J. W. Tomlinson, "M.E.", April 7th issue. It would seem that Mr. Tomlinson is not conversant with the general usage of the pipe cone in question, it obviously belongs to a compression joint and the manufacturers of these joints use the fact that no brazing or soldering is required as one of their strongest selling points. Neither was I referring to their use in domestic work, although the joints are the same with the exception that they are usually heavier for high-pressure work.

My reference was to these joints carrying hundreds of pounds pressure, therefore, the domestic question was right out of the picture, as no domestic system would be carrying hundreds of pounds per sq. in.

Where I am employed we have dozens of machines of all descriptions using hydraulic systems piped up with copper tube and compression joints with the cones simply slipped on to pipe and tightened up to carry any pressure up to and including 400 lb. per sq. in.

I am very well acquainted with the fact that Jack Frost will disconnect the same type of union when he thinks fit, I first met that condition many years ago.

There are, however, many varieties of these compression joints, some of which are flared out at the end or cupped, and when connected up cannot pull out.

My experience, however, also lies in the other direction, where pipe work is applied to engineering work, in which I have found the compression joints for copper tubes to be all that the makers claim for them, and it was from this experience I quoted the joints as not needing solder and being capable of very high pressure work. I have never yet seen a manufacturer of these state that solder was necessary to make a joint.

On the contrary, every one I have dealt with stresses the simplicity of the joint, and that it only requires the pipe cut to length, cone fitted, and coupled up with a suitable spanner. I have fitted some thousands of these joints, and never yet had to resort to the use of solder to make a joint.

That solder was used on these cones when used on aero engines I do not dispute ; no doubt there may have been a very good reason for it. It does not follow that that is the method in general use, neither is it general practice.

When dipping a hot iron into a pot of flux, I only allow the extreme point to touch the flux ; there is no need to drown the iron. Another method which I have used is to touch the point of the iron with a wet flux brush, which will give the same result.

Preheating did not enter into my failure to do the particular job in question, as I was using a bunsen flame. I still maintain that a flux such as Baker's fluid is suitable to use where the parts can be washed after soldering.

I would not call this particular acid flux dirty when used with plenty of heat ; corrosive, yes, if not washed off after the job is finished. I don't know what is meant by dangerous unless Mr. J. W. Tomlinson refers to the splutter from the flux when in use and that it may fall on the operator's skin, where I agree it is not always pleasant.

I will make no comment on Mr. J. W. Tomlinson's reference to "modern technique" other than to say that the "old school" are of necessity the people most likely to be in contact with and to use whatever new or improved ideas which come along, together with new types of solder, etc. After all, an employer does not engage a new hand every time this, that, or the other improvement comes along, he usually gives the new material or tool to one of his "old hands," who, he is reasonably sure, can be trusted to give fair trial and comment on the article in question.

There is an article in the issues of THE MODEL ENGINEER dated September 19th and 26th, 1935, on compression joints on pipe work.

Yours faithfully,

Poole, Dorset. D. NICHOLSON.

"Twin Sisters"

DEAR SIR,—First, let me congratulate Mr. Austen-Walton for giving us in the "Twin Sisters," an engine that is going to be a real engineering job. No doubt, something that is simple to make and will give a good performance, meets the most popular demand ; but I, for one, am pleased to find in the "Twin Sisters" the answer in steam to Mr. Westbury's "1831."

No doubt it is of interest to Mr. Austen-Walton at this stage to hear from those of us who have determined to make a start, as I have always imagined contributors to THE MODEL ENGINEER to be rather like radio comedians, a bit in the dark regarding their audience.

The first article convinced me that we could look forward to some particularly interesting detail work in the "Major," and so far everything has turned out well up to expectations. I am afraid that I was one of the poor fools who could not resist the temptation when stainless steel was mentioned for the main-frames, and have had consequently to divide my time just about equally between doing the job and obtaining the materials. Stainless steel, 8-gauge, was a particularly difficult search, but I was eventually fortunate in locating some, lever sheared, and set to work flattening it. All went well until I unbolted the two plates, when I thought they were going to curl round my neck ; anyway, I have got them reasonably flat again, and the important dimensions do not seem to have suffered. What a fortune hacksaw-blade manufacturers must have made ! I was only able to obtain two or three high-speed steel blades, and had snapped them like carrots before I became accustomed to treat them with the respect they demanded.

I have put in all the $\frac{1}{16}$-in. rivet holes, and was a bit disappointed to read that Mr. Austen-

Walton does not intend to use them all for their legitimate purpose. Incidentally, my only equipment is a $3\frac{1}{2}$-in. Myford, and all my drilling has to be done on this. The back gear is certainly very useful for drilling the large holes and I find it takes all the available power, but for the small holes it is not very sensitive.

For the diaphragms and other plate work, I have again used stainless steel, and have found the flanging and filing reasonably straightforward. To overcome the slight variations in the $3\frac{15}{16}$ in. dimensions, I am thinking of running a pair of ganged milling-cutters along the two flanges just to clean them up, and I hope this will provide flat and true riveting faces, and all of the exact width to fit between the frames. The cover-plates on the front stretchers I have made with raised flanges on the outer edges, and I have bolted the plates in position with 10-B.A. hex. bolts. To my mind, this is a small improvement, and the appearance is very pleasing.

Now for my first grumble, having obtained just sufficient 8-gauge plate for the main frames, I shall now have to start the search all over again for a bit more for, the buffer-planks. I think Mr. Austen-Walton might have given us the tip regarding our material requirements a little sooner, or at least told us to get a little extra, as the buffer-planks were made in the same material. As most of us no doubt have a great deal of trouble in procuring just the right material, I think it would help us a lot if a rough material schedule could be provided. Certain items of material do become available to us, from time to time, and if we knew what was required we could, perhaps, get it when it is available and so have it to hand when the time comes to make a start on any particular part.

Yours faithfully,

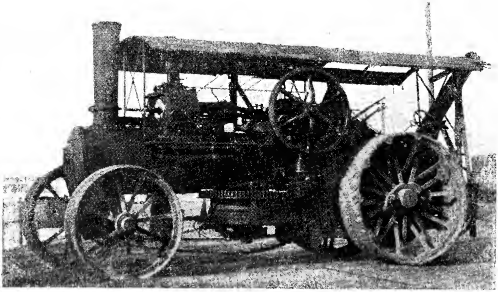
London, S.W.12. A. A. SMITH.

The Southampton "Ploughing" Engines

DEAR SIR,—I have just noticed your editorial note in THE MODEL ENGINEER of March 24th, referring to the Fowler engines working here.

Your correspondent was unaware that a reader of THE MODEL ENGINEER since 1913 (myself) was in even closer contact with these engines and had duly recorded the event.

Three of these engines have been used by a firm of contractors as part of their equipment for excavating "hards" over which 100,000 military vehicles passed on their way to Normandy. They were used to haul specially designed dragline



shovels which brought brick rubble close in to the shore, whence it was removed by the ordinary Ruston Bucyrus type of excavator.

There is no doubt that these engines provided the ideal motive power for the purpose, but the finishing of the surface left something to be desired, as the bucket tended to wander along soft spots and cut valleys for itself.

The photograph reproduced above, shows Fowler No. 16719, the same engine as the one shown on page 481 of the issue of May 6th, 1948. Comparison of the two photographs reveals little alteration, but the earlier photograph does not appear to show a piston-rod extension which is clear in the later snap.

Another item of interest connected with the use of these engines here is that in excavating the wartime material, some of which had sunk deep into the mud of centuries, a number of old pile stumps were uncovered. Some of these are known to be over a century old, but others are so ancient that the only clue to their age exists in documents of the 13th century. These stumps are of oak, probably from the New Forest, and still show the tool marks where the point has been hewn.

Yours faithfully,

Southampton. "CIVIL."